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First records of *Mylonchulus brachyuris* (Bütschli, 1873) (Nematoda, Mononchida, Mylonchulidae) from South Kalimantan, Indonesia

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Abstract

Mononchids are predatory soil nematodes of ecological and agricultural importance. Our morphological examination of preserved mononchid specimens collected from South Kalimantan, Indonesia, revealed that they are *Mylonchulus brachyuris* (Bütschli, 1873). The morphological characters of these South Kalimantan specimens generally fit the published descriptions of this species. However, they have some deviations which are considered to be intraspecific variations and contribute to a redescription of the species. This is the first report of *M. brachyuris* from Indonesia, expanding the the distribution of the genus *Mylonchulus* Cobb, 1916 and adding to the nematode fauna in the Indonesian archipelago.

Keywords

Borneo, description, identification, mononchid, morphology, nematodes

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Introduction

Mononchids are predatory nematodes that can easily be recognized owing to their prominent buccal cavity and feeding apparatus. They can be found in all kinds of soils, and in much greater number in undisturbed soils (Ahmad and Jairajpuri 2010). One of the most widely distributed genera of mononchids is *Mylonchulus* Cobb, 1916. Species of this genus have been reported from Western, Central, and Eastern Europe; North, Central and South America; Africa (Egypt, South Africa, Nigeria, Zaire, Congo, and Mauritius); Asia (India, Pakistan, Nepal, Iran, Vietnam, Thailand, Malaysia, Singapore, Brunei, Indonesia, Korea, Japan); and Oceania (Hawaii, Fiji, New Caledonia, Australia, New Zealand, New Guinea) (Andrassy 1992; Ahmad and Jairajpuri 2010).

In Indonesia, *Mylonchulus lacustris* (Cobb, 1915) has been collected from Sumatra and Java (Schneider 1937). No further records of the species have been made, and no other *Mylonchulus* species have since been reported from Indonesia, despite some statements on the occurrence of the genus from the country (Suatmadji et al. 1988; Gafur 2006).

During nematode surveys held in South Kalimantan

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in 2005 and 2016-2017, specimens of mononchids were collected and preserved. These were identified as belonging to the genus *Mylonchulus*. In the present study, we examined these specimens further and identified them as *M. brachyuris* (Bütschli, 1873). They are the basis of the first records of this species in Indonesia.

Methods

During the 2005 survey, mononchid nematodes were collected from several localities in the District of Banjar, Borneo, Indonesia. Subsequent surveys in 2016 and 2017 found specimens from the Districts of Banjar and Tanah Laut, also in Borneo (Fig. 1).

Nematodes were extracted from soils using the Whitehead and Hemming (1965) tray method. Nematodes found were killed, fixed in hot 4% formalin, and transferred to pure glycerine using the rapid method of Seinhorst (1959). The 2005 specimens were mounted in Cobb's double coverslip slides, while subsequent specimens were mounted in conventional microscope slides plus coverslip. All specimens were deposited in the Koleksi Nasional Nematoda Universitas Lambung Mangkurat (KNNULM; curator A. Gafur) at Laboratorium Biosistematika, Fakultas Matematika dan Ilmu Pengetahuan Alam, Universitas Lambung Mangkurat.

Specimens were examined under a Nikon E100 compound microscope equipped with an Amscope MU900 digital camera connected to a laptop. Morphometric measurements were taken using the dedicated software of the camera (Amscope version: x64, 4.11.17864.20201020) that had been calibrated with an ocular micrometer.

Results

Mylonchulus brachyuris (Bütschli, 1873)

Materials examined. INDONESIA – **Kalimantan Selatan Province** • Aluh-Aluh Subdistrict, Aluh-Aluh Kecil Muara; −03.4344, 114.5224; 5 m alt.; 25.VII.2005; A. Gafur leg.; whole body; in rice field; 2♀, KNNULM 03.001.01 • Simpang Empat Subdistrict, Cabi; −03.2922, 115.0218; 30 m alt.; 11.X.2016; R. Adhany leg.; whole body; dragon fruit; 2♀, KNNULM 03.001.02 • Gambut Subdistrict, Banyu Hirang; −03.3772, 114.7052; 7 m alt.; 10.VII.2017; S. Aisyah leg.; whole body; cassava; 3♀, KNNULM 03.001.01.03 • Tambang Ulang Subdistrict, Sungai Jelai; −03.7112, 114.7474; 50 m alt.; 20.VII.2017; N. Halisah leg.; whole body; in corn field; 2♀, KNNULM 03.001.04.

Identification. Female (Fig. 2, Table 1). Body ventrally arcuate after fixation, tapering slightly towards extremities, posterior part more curved than anterior. Cuticle (outer and inner) smooth. Lip region slightly offset, marginally wider than adjoining body, 22 µm wide. Labial papillae slightly projecting above labial contour. Amphidial aperture located at 9–10 µm from anterior end of body. Buccal cavity heavily sclerotized, goblet or funnel-shaped, strongly tapering at base, 23–24 µm long, 14–16 µm broad. Dorsal tooth large, claw-like, located in anterior part of buccal cavity, directed anteriad; its sharply pointed apex at 71–74% of buccal cavity length from its base. Subventral walls with denticles arranged in six transverse rows, uppermost row at level of dorsal tooth apex. Subventral teeth present. Pharynx cylindroid, muscular, 25–26% of body length. Excretory pore indistinct. Junction between pharynx and intestine

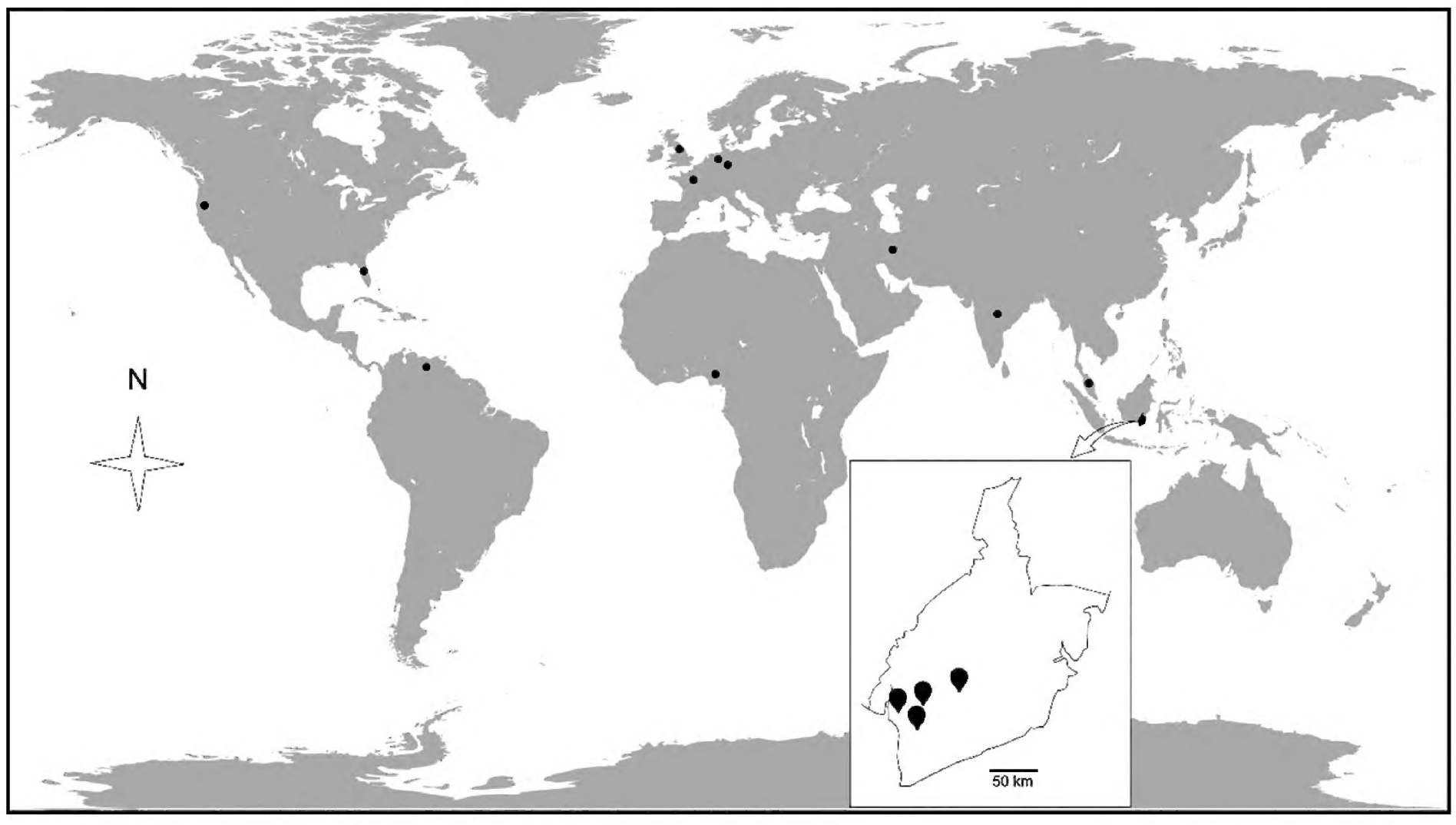

Figure 1. Distribution of *Mylonchulus brachyuris* (Bütschli, 1873). Circles on the main map indicate published occurrences worldwide. Inset map of South Kalimantan showing the four source localities of specimens for the present study.

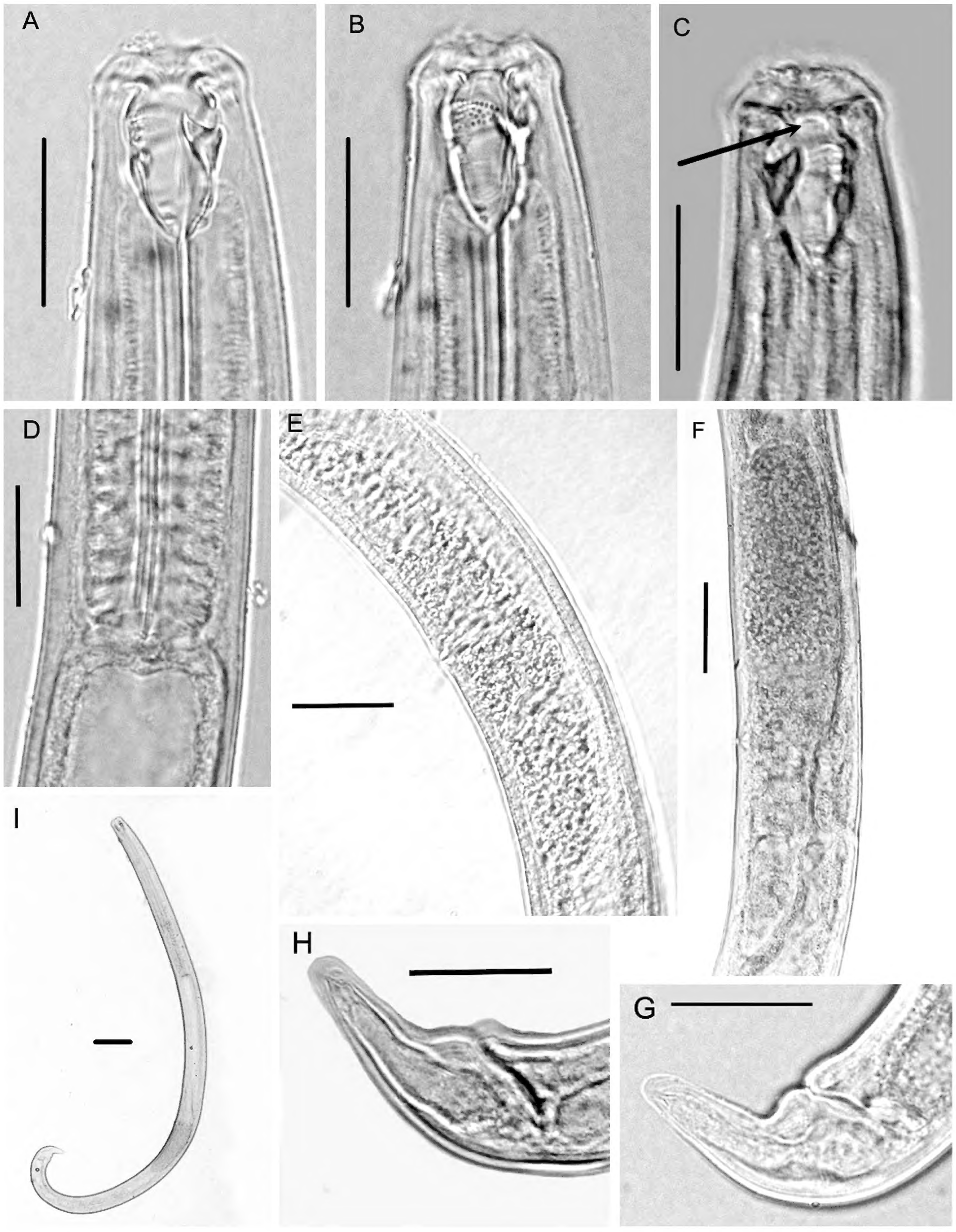

Figure 2. *Mylonchulus brachyuris* (Bütschli, 1873) mature female, lateral view. **A.** Anterior region, showing dorsal tooth. **B.** Anterior region, showing rows of denticles. **C**. Anterior region showing amphidial aperture. **D.** Esophago-intestinal junction, nontuberculate. **E, F.** Gonad. **G, H.** Tail with subdorsal opening. **I.** Whole body. Scale bars: A–H = 20 µm; I = 50 µm.

non-tuberculate. Female genital system amphidelphic, anterior and posterior branch almost equal in length. Proximal end of oviduct with large glandular cells. Vagina 12–16 µm. Rectum 21 µm, about one anal body-width long. Tail 37–41 µm, 1.6 anal body-width long, conoid, ventrally bent at half of length or closer to anus, then slightly tapering toward terminus. Caudal glands large, grouped, spinneret opening subdorsal.

Male not found.

The examined specimens showed the diagnostic

Table 1. Morphometrics of *Mylonchulus brachyuris* (Bütschli, 1873). Absolute measurements in µm; mean ± standard deviation in parenthesis.

Characters	Populations					Literature
	Aluh-Aluh (*n* = 2)	Simpang Empat (*n* = 2)	Cindai Alus (*n* = 3)	Tambang Ulang (*n* = 2)	Overall (*n* = 9)	
Body length	1245–1358	847.7–850.9	732.3–745.7	735.3–840.4	732.3–1358.0 (900.1 ± 237.0)	670–1430*
Index *a*	34–34.1	24.7–27.3	19.5–28.1	22.0–26.1	19.5–34.1 (26.9 ± 4.8)	20–36*
Index *b*	3.5–3.7	3.3	3.0–3.1	3.2	3.0–3.7 (3.3 ± 0.2)	3.1–4.2*
Index *c*	29.2–32.6	24.8–26.3	25.9–34.1	26.2–31.8	24.8–34.1 (28.3 ± 3.3)	23.2–51*
Index *c'*	1.5–1.8	1.6	1.1–1.7	1.5–1.6	1.1–1.8 (1.5 ± 0.2)	1–1.8‡
Index *V*	62.5–63.1	57.3–58.2	56.3–61	58.0–58.2	56.3–63.1 (59.4 ± 2.3)	56–65*
% pharynx	25.2–26.1	27.2–30.8	28.9–30.5	28.2–28.7	25.2–30.8 (28.4 ± 2.0)	—
Max. body width	36.6–39.8	31–34.5	26.1–37.8	32.1–34.1	26.1–39.8 (33.3 ± 4.3)	—
Tail length	38.2–46.5	32.4–34.2	21.6–28.3	26.04–32.1	21.6–46.5 (31.8 ± 7.4)	23–55*
Pharynx length	324.9–341.9	231.3–260.9	211.8–225.1	211.6–237.1	211.6–341.9 (252.1 ± 48.6)	279–360.5+
Anal body width	24.9–26	20.8–24.7	16.6–19.6	17.0–20.8	16.6–26 (20.6 ± 3.2)	23–35+
Buccal cavity length	24.5–25.2	20.6–21.2	17.4–19.4	17.9–19.3	17.4–25.2 (20.0 ± 2.9)	18–26*
Buccal cavity width	11.7–11.8	10.0–10.4	9.0–9.6	9.5–10.9	9.0–11.8 (10.1 ± 1.0)	10–16.8*
Dorsal tooth apex from buccal cavity base	18.1–19.9	14.9	13.2–15.3	14.1–14.9	13.2–19.9 (15.6 ± 2.1)	16–19@
Dorsal tooth apex % buccal cavity length	73.9–79.0	75.9–78.1	75.9–85.8	77.2–80.5	73.9–85.8 (78.3 ± 3.4)	72.2–87.5±
Lip region width	20.9–21.5	18.8–23.8	18.3–19.3	17.5–21.0	17.5–23.8 (19.1 ± 1.3)	20–28‡
Lip region height	6.7–7.1	6.5–7	6.5–6.6	6.2–7.5	6.2–7.5 (6.4 ± 1.0)	8.4–9.8#
Rectum length	17.1–19.4	19.2–21	15.8–21.2	14.8–19	14.8–21.2 (18.0 ± 1.7)	18–42.5$

a = body length ÷ maximum body width
b = body length ÷ distance from anterior to esophagointestinal junction
c = body length ÷ tail length
c' = tail length ÷ anal body width
V = distance from anterior to vulva ÷ body length, in percent
% pharynx = distance from anterior to esophagointestinal junction ÷ body length, in percent
*Mulvey (1961), Jensen and Mulvey (1968), Jairajpuri (1970), Chaves (1990), Loof et al. (1990), Loof (2006), Farahmand et al. (2009).
‡Chaves (1990), Loof (2006), Farahmand et al. (2009)
+Loof (2006), Farahmand et al. (2009)
$Jairajpuri (1970), Farahmand et al. (2009)
± Chaves (1990), Farahmand et al. (2009)
#Farahmand et al. (2009)
@Jairajpuri (1970)

characters of the genus *Mylonchulus* as described by Ahmad and Jairajpuri (2010): broad goblet-shaped buccal cavity with claw-like dorsal tooth obliquely directed anteriad, subventral walls with small teeth in addition to denticles in transverse rows forming rasp-like field; non-tuberculate pharyngo-intestinal junction; and amphidelphic female genital system.

We attribute our South Kalimantan specimens to *M. brachyuris* based on the possession of the following features: caudal glands with subdorsal terminal opening, tail shorter than 1.5 anal body diameter, buccal cavity length ≤20 µm, and body length ≤1500 µm. General morphology of the specimens conforms well with the descriptions of *M. brachyuris* as given by Jairajpuri (1970) and Loof (2006) and the dichotomous key by Ahmad and Jairajpuri (2010).

Morphometric characters of our specimens, compared with those of *M. brachyuris* in the literature (Table 1), show that absolute measurements are at the lower end of the ranges, and some even beyond the lower limits. However, indices were practically within the ranges. Therefore, even though the examined specimens were smaller, the proportions of different parts of the body correspond to *M. brachyuris*.

Discussion

Compared to previous reports of *Mylonchulus brachyuris*, our South Kalimantan specimens showed some differences in the shape of the tail. Although these specimens conform to the general description of the tail of *M. brachyuris*, as ventrally arcuate with the dorsal side regularly rounded (Fig. 2F), compared to published drawings of *M. brachyuris* (Mulvey and Jensen 1967: fig. 84; Farahmand et al. 2009: fig. 3L; Jairajpuri 1970: fig. 3C, D; Loof 2006: fig. 13C), the tails of our specimens seemed less plump and showed stronger ventral bending, some even almost a right angle. Our specimens agree with *M. williamsi* Loof, 2006 (a synonym of *M. brachyuris* according to Ahmad and Jairajpuri 2010) in having a tail with a tapering terminal part and a subdorsal spinneret opening (Loof 2006: fig. 15D, E), but some specimens differ in having the ventral bend at approximately half of the tail length (versus closer to the anal opening). The

tail is similar to that of *M. hawaiiensis* (Cassidy, 1931) (Chaves 1990: fig. 1B; Jairajpuri 1970: fig. 2C, D; Khan and Jairajpuri 1979: fig. 3E; Mulvey and Jensen 1967: figs. 91, 92), *M. californicus* Jairajpuri, 1970 (Jairajpuri 1970: fig. 4B), and *M. minor* (Cobb, 1893) (Mulvey and Jensen 1967: figs. 99, 100; Tahseen et al. 2013: fig. 3W, X) in having the ventral bend but differs in having a subdorsal spinneret opening (versus terminal) and tapering terminal part (versus clavate). Our observation suggests that the tail of *M. brachyuris* shows characteristic tapering terminal part and subdorsal opening, and intraspecific variation in the position (halfway to closer to the anus) and development (weak to strong) of the ventral bend. This should appear in the future redescription of *M. brachyuris*.

Farahmand et al. (2009) and Chaves (1990) described that the head or lip region of *M. brachyuris* is slightly set off from adjoining body and gave a supporting photograph (Farahmand et al. 2009: fig. 4C) and line drawing (Chaves 1990: fig. 1A), respectively. Jairajpuri (1970) and Loof (2006) did not mention this distinctive character, but the in their figures of the species (Jairajpuri 1970: fig. 3A; Loof 2006: fig. 13A), the head contour was drawn with labial papillae, as shown by Chaves (1990), which gives the impression that the head is somewhat set off. Our specimens also show this (Fig. 2A–C).

Morphometric measurements of our South Kalimantan specimens show that they are generally smaller within the ranges as reported in the literature for *M. brachyuris* (Mulvey 1961; Jensen and Mulvey 1968; Jairajpuri 1970; Chaves 1990; Loof et al. 1990; Loof 2006; Farahmand et al. 2009). In all absolute measurements (Table 1), except body length, there were specimens smaller than the reported ranges. Therefore, our specimens extended the lower limit of most morphometric character ranges of *M. brachyuris*. This should also be incorporated in the future redescription of the species.

Comparison of morphometric characters of our specimens with those from Venezuela (Mulvey 1961) provides interesting insights. In body length, which reflects body size, Venezuelan specimens were the shortest (670–1080 µm) and constitute the smallest specimens of *M. brachyuris* ever recorded. However, our specimens had the shortest tails (21.6–46.5 µm versus 27.0–42.0 µm). Some of our specimens had proportionately shorter tails, relative to body size, as was reflected in higher lower limit of index c (24.8–34.1 µm versus 23.2–27.0 µm) than the Venezuelan specimens. In buccal cavity dimension, some of our specimens similarly were smaller than the Venezuelan specimens (17–25 × 9–12 µm versus 18–20 × 10 µm), indicating a proportionately less spacious buccal cavity relative to body size.

In Indonesia, the only species of *Mylonchulus* reported so far has been *Mylonchulus lacustris* (Cobb, 1915) collected from Sumatera and Java (Schneider 1937), as well as northern Borneo (Tsalolikhin et al. 2012). Our specimens from South Kalimantan, Borneo, noticeably differ from this species in the following features: body length <1360 µm (versus >1800 µm); subventral walls of stoma with six transverse rows of denticles (versus seven); tail more slender (c′ = 1.1–1.8 versus 2.0) with some degree of ventral bending (versus ventrally curved without bending); vulva at mid-body (V% = 56–63, versus more posterior, V% = 64–65). These differences confirm that the South Kalimantan specimens are not *M. lacustris*.

Another species found in Borneo, *Mylonchulus sessus* Jairajpuri, 1982, has been reported from Brunei (Jairajpuri 1982). Our specimens differed from this species in having: body length <1360 µm (versus >1380 µm); subventral walls of stoma with six transverse rows of denticles (versus seven or eight); tail proportionally longer with c <34.1 (versus ≥47), more slender with c′ = 1.1–1.8 (versus 0.9), and with subdorsal spinneret opening (versus terminal); and rectum shorter, <21 µm (versus >29 µm). Thus, we conclude that our specimens are not *M. sessus*.

Despite the absence of records of other species of *Mylonchulus* from other parts of Indonesia, in view of the wide distribution of the genus around the world, there is a good possibility that additional *Mylonchulus* species can be found in the country. Because mononchs are predatory nematodes which can suppress plant-parasitic nematodes (Stirling 2014), this group may be of importance in agriculture. Hence, more inventory of this genus will stimulate and contribute to research on the biological control of crop pests.

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Authors' Contributions

Conceptualization: AG. Data curation: AG, AA. Funding acquisition: AG, AA. Methodology: AG. Project administration: AA. Validation: AA. Visualization: AG. Writing – original draft: AG. Writing – review and editing: AG, AA.

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